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## Non-fungible tokens

**Florian Idelberger** *European University Institute*

**Péter Mezei** *University of Szeged* [mezei@juris.u-szeged.hu](mailto:mezei@juris.u-szeged.hu)



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**Abstract:** Blockchain-based NFTs (non-fungible tokens) are uniquely identifiable digital representations of physical or digital items. Usually, the tokens are indivisible into smaller units. NFTs represent structured metadata referring to physical or digital objects. The tokens act for a separate identifier and are often not tied to the objects. Their proponents claim they further the interoperable commercialisation of digital or physical goods.

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## Definition

Blockchain-based NFTs (non-fungible tokens) are uniquely identifiable digital representations of physical or digital items. Usually, the tokens are indivisible into smaller units. NFTs represent structured metadata referring to physical or digital objects. The tokens act for a separate identifier and are often not tied to the objects. Their proponents claim they further the interoperable commercialisation of digital or physical goods.

## Origin and evolution

Already back in 2012-2013, hashes of files or other data were incorporated into the Bitcoin blockchain to prove existence or authenticity from a specific point in time (de Beauchesne, 2021). This development was built upon to create so-called 'Colored Coins', tokens that are uniquely identified by adding metadata to Bitcoin transactions, and Namecoin, a separate blockchain that deploys tokens for registering domain names, to establish an alternative, decentralised top-level domain name system (*Namecoin*, 2022). A further experiment was Counterparty, which featured expanded capabilities for more general-purpose applications of NFTs on the Bitcoin blockchain and the first blockchain-based trading cards (Portion.io, 2021).

With the Ethereum blockchain launch, these experiments picked up steam and led to tokens functioning as collectables depicting digital pixel art such as CryptoPunks in 2017.

The details of most current non-fungible tokens (NFTs) are described in a technical standard called ERC-721 (*ERC-721 Non-Fungible Token Standard*, 2018). This standard describes the required metadata of the NFT and the executable functions the underlying smart contract has to support to work with existing infrastructure such as trading websites and other interfaces. The standard refers to the Ethereum blockchain, the most popular one as of writing, but many other implementations are based on the Ethereum standard. ERC-721 is based on an Ethereum Improvement Proposal (EIP) and was finalised in 2018, shortly after Cryptokitties (*CryptoKitties*, 2021), a game to collect and multiply digital cats, first became popular in 2017.

From 2018 on, the projects and companies expanded even more and diversified their operations. NFTs started reaching the fine art market regarding pricing, with Beeple's 'First 5000 Days' selling for 69 million (Christie's, 2021). Shortly thereafter, they were diversified further with the minting of, e.g. tweets (Howcroft, 2021), newspaper covers (The Economist, 2021) and even law review articles (Newsham, 2021). Fueled by venture capital, cryptocurrency investments and hype, marketplaces and surrounding infrastructure expanded massively (Mattei, 2021). At the end of 2021, a developer tokenised 'Cryptogotchis', the most expensive Tamagotchi clone ever (*Cryptogotchi Home*, 2021). As a result of this expansion, there have also been music songs, physical objects, academic papers, and much more put into NFTs. Sometimes these were just experiments, some were founders or investors looking for their own niche, yet others claim this process of tokenisation will bring about a new property system.

As the evolution continued, the art world has been drawn into cooperations between established art world institutions like Art Basel and technology companies. These cooperations are partly driven by profit motives with cryptocurrency proponents promising improved artist remuneration, disintermediation and easier compliance with upcoming anti-money-laundering regulations (Brown, 2021; Ryan, 2021).

## Creation

Minting is the act of creating an NFT. In this process, a user creates a new set of NFT data by sending a transaction to an underlying smart contract that supports NFTs, as described in ERC-721. It is assigned a blockchain contract address and a tokenId, which in combination form a globally unique identifier. Additional metadata can be (optionally) added. Crucially, the tokenised work is not necessary for minting, and not even a hash of the work has to be stored in the NFT (Guadamuz, 2021c; Bodó et al., forthcoming, 2022).

There are three main types of NFTs, based on how they relate to the digital or physical asset they represent. First, for certain NFTs, the work is uploaded to the blockchain; this, for example, can happen with code generating art or vector art. This type of NFT is relatively rare due to the high costs of storing data on the blockchain. Secondly, other NFTs incorporate ownership rights, either by specifying them in the NFTs metadata or via a reference to external terms and conditions (such as on Mintable); in both cases, ownership can be transferred via blockchain transactions (Foo, 2021). Finally, the most used type of NFTs do not confer any rights or favour a commons-based licence such as CC0, which also does not confer

rights on the token owner, as rights are granted publicly (Guadamuz, 2021b).

## Issues

NFTs raise several issues, the most relevant of which are the uncertainty about the legal rights and economic benefits they confer and the environmental impact of the underlying blockchain technology.

The ease of creating ‘digital editions’ of either art or collectables in an open and economically liquid network made for value transfer has partially opened up new revenue streams for artists, museums (Willis, 2021) and companies. Some proponents also argue that “NFTs might be able to democratise art” (Gibson, 2021), as they allow a broad spectrum of people to disseminate their born-digital art and to be remunerated for such dissemination. Contrary to claims from NFT projects, however, there is currently no evidence that it improves artists’ struggles to earn a living (with some notable exceptions) compared to other forms of online monetisation (Dash, 2021; Ryan, 2021).

From a copyright perspective, NFTs do not work to provide a living for many artists, as they are freely accessible, and thus already established artists and those who can grow a following (especially among crypto natives) are the ones that thrive (Bruner, 2021). Compared to other popular content such as streaming services, NFTs are not protected by digital rights management and thus can be enjoyed by anyone and many people at the same time. This ‘non-rivalrous nature’ only works for artists with clout and networks by creating artificial scarcity (Brekke & Fischer, 2021) via artificially limiting not the work but the reference to it. Nevertheless, the art itself can still be enjoyed and copied by anyone. In the absence of property rights, an NFT is essentially often only a unique global identifier for a reference to a work (Moringiello & Odinet, forthcoming).

As a result, on the one side, NFT proponents describe these bits of metadata as the start of a new economic system and the liberation of the art and the artists from the oppressive forces of the art market, whereas opponents and sceptics see it as capitalism in overdrive due to the commoditisation and securitisation of art (Ryan, 2021). Commoditisation refers to treating art as yet another tradeable good instead of something with its own value independent of money. Securitisation refers to turning everything into a financial instrument for financial speculation, which then also allows fractionalisation (splitting into shares) of an asset. (Rabouin, 2021). Decrying rampant fraud and speculation, NFTs’ opponents claim that the economic models used by NFT projects do not offer any non-capitalist incentives

such as a fairer economic system (Ivie, 2021; Moringiello & Odinet, forthcoming).

Regarding the environmental concerns, most NFTs today exist on *proof-of-work* blockchains which require vast amounts of energy to power their security and functioning, which is criticised due to their environmental footprint. There are *proof-of-stake* based blockchains or second layer systems either in development or already available to alleviate the environmental impact. However, for now, the amount of energy required is an essential argument against NFTs, same as with many public blockchains (Alsindi & Lotti, 2021).

Other technical and socio-legal issues raised by NFTs are that of disappearing links ('link rot') and allegations of fraud and money laundering. With many NFTs containing only a link to the tokenised content, "link rot" is a pressing concern. This term describes the situation where the hyperlink no longer points to its target because it is no longer available through the corresponding hosting service. In the case of a decentralised storage system such as IPFS, it is dependent on someone sharing this via their node or paying for 'pinning' as a service (Kastrenakes, 2021). Finally, there have also been allegations of money laundering. Specific projects, especially those featuring collectables, have sometimes disappeared right after selling all their generated NFTs (Department of Justice, 2022). These cast any positive aspects of NFTs into doubt (Teitelbaum, 2022; Bodó et al., forthcoming, 2022).

## Copyright-related aspects of NFTs

NFTs and copyright law have two significant zones of interaction. The first is related to the 'minting' when NFTs are created, and the second is focused on the dissemination of the digitised works.

Without any doubt, the *content behind the NFT* can be subject to copyright protection. The threshold of originality (whether a work is original enough to be protected by copyright) is the prerequisite of protection under copyright law (of the European Union), and this threshold is low under the case law of the Court of Justice of the European Union (Bodó et al., 2022, forthcoming). Hence, even pixel-based art (e.g. CryptoPunks) can meet such requirements. Likewise, plenty of other traditional copyright concepts remain applicable for tokenised digital artworks, e.g. moral rights protect authors against misappropriation; other examples are "copyfraud" cases (that is, minting by non-owners of artworks) (Guadamuz, 2021a) and traditional licensing mechanisms.

The use of the tokens referencing a copyrighted work leads to more substantial

copyright challenges. First, posting a digital image on a website (e.g. OpenSea) can infringe on the economic right of making available to the public by the author. (In the European Union, Article 3 of the InfoSoc Directive grants this right to authors and related rights holders with respect to on-demand use). Second, it is far from certain that the offering for “sale” of the NFT itself represents a “use” in a traditional copyright sense. It is plausible that the transfer of NFTs does not fit into the right of distribution, as distribution is relevant mainly for the transfer of ownership of tangible copies of works. Offering access to digital copies is instead treated as the making available of that copy to the public. The CJEU’s judgement confirmed this in the *Tom Kabinet* case (*C-163/18 Tom Kabinet*, 2019). The same judgement concluded that the doctrine of exhaustion should remain inapplicable in the digital domain for works other than software (Bodó et al., forthcoming, 2022).

A source of tension between the NFT world and copyright laws is the misleading use of copyright-related terminology. The use of copyright terminology creates the illusion that NFTs naturally incorporate property rights. Furthermore, claims of authenticity are made based on links to a work even when no legal connection between such work and the token is established (Moringiello & Odinet, forthcoming, p. 24). The acquisition of ownership interests is seldom associated with acquiring a token, and platforms often make no efforts to verify authenticity. There is even a project that allows automated ‘cloning’ of an NFT by minting it yourself (*Knockoff NFTs*, 2021).

With NFTs, sellers can set their own terms. These terms can consist in traditional transfer of rights, possibility to use the NFT to unlock additional content, or a ‘digital resale royalty’. Such rights can be granted either via traditional licensing agreement or by attaching additional terms to the NFT. In any case, creators and owners of NFTs are in a powerful position to control the fate of their creations (Lapatoura, 2021, p. 171).

There have been attempts even before the rise in popularity of NFTs to use blockchain-based systems for a registration system for copyrighted works—but all failed (Bodó et al., 2018) Some were too early (ascribe), others were just experiments (Ujo), and existing stakeholders such as collecting societies and publishers likely have little to gain from making their licensing more transparent. However, for consumers and smaller artists, transparency about who earns how much could be very beneficial. In a recent development, the Italian collecting society SIAE plans to launch NFTs for the creators it represents on Algorand, an alternative blockchain with higher throughput and much-reduced energy needs. It is unknown how this plays out and what the benefits are, especially as the most significant is-

sues for collecting societies are finding infringement and enforcement (Bodó et al., forthcoming, 2022)

A similar public policy issue is the minting of public domain works. Such tokenisation might not be prohibited, as the original work is not necessary for the minting. Still, it invokes a strong reaction in parts of society when profits are made in such a way off public or free works (Guadamuz, 2021c).

## Conclusion

NFTs give their holders the illusion of ownership; in other words, they are a “cryptographically signed receipt that you own a unique version of a work” (Guadamuz, 2021c). However, the possession of an NFT does not necessarily confer any legal right over the digital or physical object that the NFT refers to. Several proposals have been advanced to overcome this limitation to the concept of NFT. Some instantiations try to forego the law in favour of technical solutions, sticking to the idea that ‘code is law’; others try to strike a balance between the legal and the technical dimension, incorporating aspects of copyright law into the metadata of the NFT or in accompanying documentation; finally, others propose to incorporate the actual work into the underlying smart contract. While many commentators are critical at this point (Ryan, 2021), others, like Fairfield, see the potential of NFTs as forms of ‘unique digital property’, reestablishing personal property rights that have been lost to user agreements and other instruments of uneven bargaining power (Fairfield, 2021).

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